

CLAIMS

What is claimed is:

1. An operating apparatus comprising:
 - a driven element;
 - a frame which rotatably supports the driven element;
 - a contacted element which is stationary with respect to the frame; and
 - a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the vibrating element being fixedly mounted on the driven element in a state where the contact portion abuts on the contacted element;

wherein the vibrating element receives reaction force from the contacted element when the vibrating element vibrates so that the driven element is rotated together with the vibrating element by means of the reaction force.
2. The operating apparatus as claimed in claim 1, wherein the contacted element is fixedly provided on the frame.

3. The operating apparatus as claimed in claim 1, wherein the vibrating element has a thin plate-shaped structure, and the contacted element and the vibrating element are provided in a substantially same plane.

4. The operating apparatus as claimed in claim 1, wherein the driven element has a side surface and the frame has an inner wall surface which is opposite to the side surface of the driven element through a gap therebetween, and the contacted element and the vibrating element are arranged within the gap.

5. The operating apparatus as claimed in claim 1, wherein the driven element has a bottom portion, and the vibrating element is provided on the bottom portion of the driven element.

6. The operating apparatus as claimed in claim 5, wherein the vibrating element is provided in an area in which the driven element rotates.

7. The operating apparatus as claimed in claim 1, wherein the contacted element forms a part of the frame.

8. The operating apparatus as claimed in claim 1, further comprising means for pushing one of the contacted element and the vibrating element toward the other.

9. The operating apparatus as claimed in claim 1, wherein the contacted element is a protruding portion provided on the inner wall surface of the frame.

10. The operating apparatus as claimed in claim 1, wherein the driven element is an imaging device having an optical system.

11. The operating apparatus as claimed in claim 1, wherein the driven element is a device for detecting sound.

12. The operating apparatus as claimed in claim 1, wherein the driven element is a device for adjusting the center of gravity.

13. The operating apparatus as claimed in claim 1, wherein the driven element is a radio-wave detecting device having a portion for receiving radio waves.

14. An operating apparatus comprising:
a driven element on which a contacted element is rotatably provided;
a frame which rotatably supports the driven element;
a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a

reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the vibrating element being fixedly mounted on the driven element in a state where the contact portion abuts on the contacted element; and

a decelerating mechanism provided between the contacted element and the frame;

wherein the vibrating element transmits power to the driven element via the contacted element and the decelerating mechanism to rotate the driven element together with the vibrating element.

15. The operating apparatus as claimed in claim 14, wherein the driven element is an imaging device having an optical system.

16. The operating apparatus as claimed in claim 14, wherein the driven element is a device for detecting sound.

17. The operating apparatus as claimed in claim 14, wherein the driven element is a device for adjusting the center of gravity.

18. The operating apparatus as claimed in claim 14, wherein the driven element is a radio-wave detecting device having a portion for receiving radio waves.

19. An electric instrument provided with an operating apparatus, the operating apparatus comprising:

a driven element;

a frame which rotatably supports the driven element;

a contacted element which is stationary with respect to the frame; and

a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the vibrating element being fixedly mounted on the driven element in a state where the contact portion abuts on the contacted element;

wherein the vibrating element receives reaction force from the contacted element when the vibrating element vibrates so that the driven element is rotated together with the vibrating element by means of the reaction force.

20. An electric instrument provided with an operating apparatus, the operating apparatus comprising:

a driven element on which a contacted element is rotatably provided;

a frame which rotatably supports the driven element;

a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the vibrating element being fixedly mounted on the driven element in a state where the contact portion abuts on the contacted element; and

a decelerating mechanism provided between the contacted element and the frame;

wherein the vibrating element transmits power to the driven element via the contacted element and the decelerating mechanism to rotate the driven element together with the vibrating element.